

Health of Galveston Bay for Human Use

Estuaries are expected to support a variety of human uses, ranging from commercial and recreational fisheries to marine transportation to discharge of chemical and thermal wastes. How well estuaries are meeting these human uses is one measure of coastal condition. Traditionally, coastal condition is described in terms of the effects of human activities on one or more environmental metrics. The previous chapters have followed this traditional approach and have used the results of estuarine assessments to describe the current condition of coastal resources in each region of the United States. This final chapter complements that approach by assessing the health of an estuary based on its ability to meet society's desired uses. Using Galveston Bay (the largest estuary of the Texas coast) as an example, this chapter will examine the following questions:

- What are society's stated uses for the system?
- How well are those uses being met?
- In instances in which a particular use is not being achieved to the desired level, are there relationships between the impairment and the National Coastal Condition Report indicators? If so, how might improving one or more of the indicators affect a particular use?

Addressing estuarine health in this manner can help researchers interpret existing data in terms of an estuary's ability to meet society's desired uses, as well as drive the collection of new data directly related to perceived problems. The first steps in enabling managers to enhance and balance those uses are to determine how society currently chooses to use these areas and to estimate the social, economic, and environmental costs and benefits of optimizing one or more uses. The relationship between coastal condition

indicators and human use impairments will be addressed in more detail in future National Coastal Condition Reports.

The type of assessment described in this chapter cannot be done on scales larger than a single estuary. Galveston Bay was chosen for this first evaluation for two reasons. First, on a very large scale, Galveston Bay supports a wide array of human uses, from industrial activities, such as oil and gas extraction and petrochemical operations, to fisheries, recreation, tourism, and marine transportation. Second, a great deal of information has been gathered and made readily available by the Galveston Bay Estuary Program (GBEP), formerly the Galveston Bay National Estuary Program (GBNEP); the Texas Parks and Wildlife Department (TPWD); the NMFS; and the USACE.

Overview of Galveston Bay

Galveston Bay (Figure 9-1) is classified as a barbuilt estuary in a drowned river delta. The open bay has a surface area of approximately 600 square miles (GBEP, 2002). With an average depth of 6 feet and a maximum nondredged depth of 10 feet, it is a shallow estuary. The watershed has an area of approximately 24,500 square miles (NOAA, 1990), which includes all or portions of 44 counties within the state of Texas. Five counties surround the estuary: Brazoria, Chambers, Galveston, Harris, and Liberty. In addition, the metropolitan areas of Houston, Dallas, and Fort Worth are also contained in the watershed.

Galveston Bay itself is commonly divided into four subbays: Galveston Bay, Trinity Bay, East Bay, and West Bay. Galveston Bay receives inflow from the San Jacinto River and local drainage from the Houston



Figure 9-1. Galveston Bay watershed.

metropolitan area via the Buffalo Bayou and its tributaries. The Trinity River empties into Trinity Bay. East Bay, on the inside of the Bolivar Peninsula, receives inflow from Oyster Bayou and from local runoff. West Bay, landward of Galveston Island, receives freshwater inflow from a series of bayous.

With an estimated input of 10 million acre-feet per year, Galveston Bay has the largest freshwater inflow volume of any estuary wholly or entirely within Texas (Martin et al., 1996), flushing the system between four and five times annually (GBNEP, 1994a). The major source of freshwater to Galveston Bay is the Trinity River, accounting for 54% of the inflow, followed by the San Jacinto River basin (28%) and the local watershed (18%) (GBNEP, 1994a).

In the upper half of Galveston Bay, salinity is typically less than 10 ppt, and it is lower near the point where the Trinity River enters the bay. In the lower half of the estuary, higher salinities are common, including salinities as high as 30 ppt at the Gulf inlet located between Galveston Island and Bolivar Peninsula (GBEP, 2002). Vertical salinity stratification is slight, averaging less than 0.6 ppt/meter. The Houston Ship Channel, which extends approximately 50 miles from Houston to the Gulf of Mexico, has also produced changes in bay circulation and salinity.

Within Galveston Bay, six major estuarine habitat types have been identified: oyster reefs, seagrass meadows, marshes, intertidal mud and sand flats, open-bay waters, and open-bay bottoms (GBEP, 2002). Species living in Galveston Bay move in and out of these areas, typically associating with one or more habitats during their life cycle.

What Does Society Want Galveston Bay to Look Like?

According to The Galveston Bay Plan: The Comprehensive Conservation and Management Plan for the Galveston Bay Ecosystem (GBNEP, 1994a) developed by the GBNEP, there are a number of land uses identified as important to society. These land uses include marine transportation; commercial and recreational fishing; receiving waters for industrial, municipal, and thermal wastes; recreational activities, such as sailing and motorboat cruising and sightseeing; habitat for fish, birds, shellfish, dolphins, reptiles, and other species; sites for oil and gas production; human residential housing; and also use as a general indicator of the health of the environment.

Society's desired uses of Galveston Bay are also reflected in land use patterns (Table 9-1). In general, urban and industrial development is concentrated on the western side of the bay, with the eastern side being more rural, dominated by agriculture and the extraction of natural resources (GBEP, 2002). There are more than 800 point source dischargers in the watershed, and many of these are wastewater treatment plants (Figure 9-2). Significant industrial activity exists around Galveston Bay, much of it centered along the Houston Ship Channel and in Texas City. As much as 50% of the nation's petrochemical production and as much as

30% of its petroleum industry can be found within the five-county area surrounding Galveston Bay (Gersten, 1995). There are approximately 50 petrochemical facilities and 40 inorganic chemical producers in the area. Manufacturing in the five counties surrounding Galveston Bay accounts for an estimated annual value of more than \$95 billion (Table 9-2).

The Port of Houston is the third largest port in the Unites States and the sixth largest in the world (Port of Houston Authority, 2003). It is used primarily by ships in support of the petroleum and petrochemical industries (Martin et al., 1996). The combined annual revenue of the Port of Houston, Texas City, and Galveston Bay has been estimated at more than \$15 billion per year.

Agriculture is a significant human use, particularly on the eastern side of the bay. The major crops in the five counties surrounding Galveston Bay include rice, sorghum, soybeans, and corn. The raising of livestock, primarily beef cattle, is also an important activity. In the five counties surrounding Galveston Bay, agriculture generates an estimated market value of more than \$130 million per year (Table 9-2).

Tourism is an important and growing use of Galveston Bay and its surrounding areas, generating an estimated \$7.5 billion in travel and payroll dollars (Martin et al., 1996). Sport fishing and associated expenditures in and around Galveston Bay have been estimated to generate as much as \$2.8 billion per year.

Galveston Bay ranks as the second most productive estuary in the United States in terms of seafood (Martin et al., 1996). The commercial fishing industry produces a total economic impact of up to \$358 million each year (Martin et al., 1996), approximately one-third of the commercial fishing income in Texas (GBEP, 2002). The most commercially valuable species from Galveston Bay are brown and white shrimp, oysters, and blue crabs.

Although Galveston Bay has been modified substantially to support human uses, large tracts of natural areas in and around the bay still remain intact, in part because of the value society has placed on these areas. For example, there are an estimated 345 square miles of wetlands in and around Galveston Bay and approximately 585 square miles of forest land. Wetlands and seagrasses are important habitats for many species and life stages of aquatic organisms that inhabit Galveston Bay.

Table 9-1. Land Use in the Galveston Bay Watershed (NOAA, 1999).					
Land Use	Lower Watershed (mi. ²)*	Upper Watershed (mi. ²)			
Urban	1,141	1,757			
Residential	31	238			
Commercial and services	4	47			
Industrial	46	12			
Transportation, communication, and utilities	7	57			
Strip mines and quarries	I	19			
Agricultural lands	1,627	9,817			
Rangeland	<	1,714			
Forest	585	5,679			
Wetlands	345	74			
Estuaries, lakes, and reservoirs	608	444			
Streams and canals	21	6			

^{*} Lower watershed or estuarine drainage is defined as that portion of the watershed downstream of the head of tide.

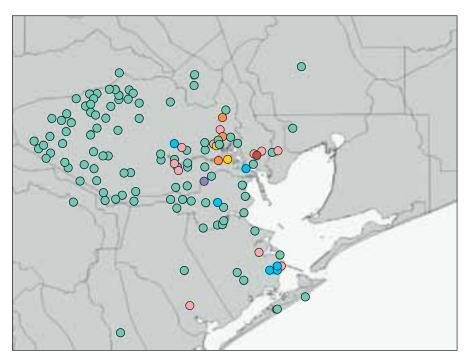
As might be expected, society wants and expects Galveston Bay to provide all of these goods and services at optimal levels. This chapter examines how well these uses are being met. In addition, it examines relationships between fisheries and improving the National Coastal Condition Report indicators in Galveston Bay.

How Well Are These Uses Being Met?

In general, the desired human uses in Galveston Bay are being met. There are indications that some of the uses could be improved, and in several cases, efforts are under way to realize these improvements.

Marine Transportation

Marine transportation is of critical importance to the Galveston Bay economy, accounting for approximately \$16 billion and over 230 million tons of cargo moved annually (Port of Houston, 2003). Work is under way to maintain this use by dredging both the Houston and Galveston Bay ship channels to accommodate today's larger ships and to enhance navigational safety (USACE, 2003). The Houston-Galveston Navigation



Point Source Facility Types

- Petroleum refineries
- Wastewater treatment plants
- Inorganic chemical production
- Synthetic rubber production
- Petroleum bulk storage
- Alkalies and chlorine production
- Agricultural chemical production
- Paper mill

Figure 9-2. Major point sources adjacent to Galveston Bay (U.S. EPA, 2004).

Table 9-2. Production and Value (\$) Estimates of Human Uses in Galveston Bay					
Use	Economic Impact	Production/Employment			
Commercial fishing	\$358 million (Martin et al., 1996)	II million lbs/year (Martin et al., 1996)			
Recreational fishing	\$2.8 billion (Martin et al., 1996)	40,000 jobs; 100,000 pleasure boats (GBEP, 2002)			
Tourism	\$7.5 billion (Martin et al., 1996)	80,000 jobs (Martin et al., 1996)			
Marine Transportation					
Port of Houston	\$11 billion (Port of Houston Authority, 2003)	175 million tons; 6,800 vessels (GBEP, 2002)			
Port of Galveston	\$440 million ¹	7 million tons; 927 vessels (GBEP, 2002)			
Port of Texas City	\$4.2 billion ¹	67 million tons; 9,600 vessels (GBEP, 2002)			
Manufacturing	\$95.3 billion				
Employment	183,000 jobs (U.S. Census Bureau, 1997)				
Agriculture	\$132 million (USDA, 1999) ²	5,558 farms; I.5 million acres (USDA, 1999)			

¹ Estimated value of cargo for Galveston Bay and Texas City calculated using per ton value from Port of Houston.

Project is a project to increase the depth of the channels from 40 to 45 feet and to widen their bottom widths from 400 to 530 feet. In addition to improving marine transportation in and out of Galveston Bay, dredge material will be used in the construction or rehabilitation of several islands and marshes. A total of nearly 4,500 acres of habitat is being created over the 50-year life of this project, as well as approximately 120 acres of oyster reefs (GBEP, 2002).

The marine commerce industry in Galveston Bay is already large, and despite ongoing efforts to accommodate growth in the industry, it is anticipated that marine commerce in the bay will overwhelm the available port facilities sometime after 2010. Planning for that growth is well under way, and environmental impact statements have been filed with the USACE to build new ports at Baytown and Texas City.

² Market value of agricultural product sold.

A Place to Live

The area around Galveston Bay is home to approximately 4 million people (GBEP, 2002), and population growth is expected to continue. The majority of the population lives in Harris County (Figure 9-3), home to significant manufacturing activities. Much of the population growth around Galveston Bay can be attributed to the growth of industry, ranging from petrochemicals to electronics manufacture (GBEP, 2002).

Although population growth in the cities of Houston and Galveston has slowed, growth in the suburban communities is expanding to meet the needs of the population. Many people also want to live near the bay itself. In Chambers County, approximately 45% of the population lives within 2 miles of the bay; in Galveston County, that figure climbs to more than 70% (GBEP, 2002).

Oil and Gas Production

The discovery of oil and gas in the early part of the twentieth century drove much of the region's growth. There are currently more than 5,300 oil wells and 1,500 gas wells in the Galveston Bay area (GBEP, 2002). Although oil and gas production is still an important industry in the region, production has decreased considerably since the 1970s (GBNEP, 1994b). In 1979, oil production in Brazoria, Chambers, Harris, and Galveston counties totaled 52 million barrels. By 2001, that figure had declined to approximately 5.4 million barrels. The decline appears to be related to external factors, such as falling oil and gas prices worldwide, which have led to less extraction of reserves in the Galveston Bay area. The crash of the oil industry in the 1980s also led to diversification of the bay area's economy.

Manufacturing

As shown in Table 9-2, manufacturing is the major economic engine in the Galveston Bay area. An estimated one-half of the total chemical production in the United States takes place in the five counties that surround Galveston Bay (GBEP, 2002). Most of this manufacturing is concentrated in Harris County. Major production categories include petrochemicals, inorganic chemicals, plastics and rubber products, fabricated metal manufacturing, machinery, and computer and

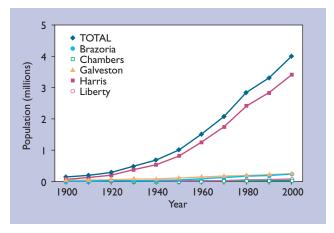


Figure 9-3. Population change in the counties surrounding Galveston Bay (U.S. Census Bureau, 2001).

electronic products. The region's economy has expanded fairly continuously over the past 50 years, indicating the continued desire for increased production of goods and services, and this trend will likely continue. In 1997, the value of shipments in the five counties surrounding Galveston Bay was approximately \$95 billion, (U.S. Census Bureau, 1997).

Recreational Activities

Recreation is important in Galveston Bay. For the most part, it appears that this use is also being met. Major activities include duck hunting, swimming, nature viewing, pleasure boating, fishing, camping, picnicking, and sightseeing (GBNEP, 1994b). With approximately 100,000 registered pleasure boats in the five counties that surround it, Galveston Bay has been called the "boating capital of Texas" (GBEP, 2002). An estimated 40% or more of the residents around Galveston Bay participate in walking, swimming, or picnicking around the bay at least annually (GBEP, 2002), and approximately 20% of the residents in the five-county area use the bay at least once a year for recreational fishing and boating (Whittington et al., 1993).

One concern related to this use, however, is that of access to the bay. Currently, public shoreline access is limited to parks and boat ramps and a few parks (GBNEP, 1994b). As the population of the region increases, the need for greater access to the bay will likely become a greater priority.

Wildlife Habitat

A habitat for wildlife is also listed as an important use in the Galveston Bay management plan. Over the years, the bay has changed significantly. One of the most obvious changes is the loss of wetlands and seagrasses. Wetlands and seagrasses have many functions within estuarine ecosystems, one of the most important being habitat for plants, fish, birds, and wildlife. In Galveston Bay, many of the fishery species of shrimp, crabs, and fish rely on wetlands and seagrasses for at least part of their life cycle (GBNEP, 1994b).

More than 33,000 acres of vegetated wetlands, or approximately 19% of the total, have been lost from Galveston Bay since the 1950s (GBNEP, 1994b). The rate of wetland loss in Galveston Bay is also higher than the national average. Four main causes have been cited: human-induced subsidence and associated relative sealevel rise; conversion of wetlands to agricultural land; dredge and fill activities; and isolation projects. Much of the subsidence was caused by the pumping of groundwater, resulting in compaction of the underlying clay layers. Some wetlands were expanded as upland areas were inundated with water, but overall, losses exceed gains. Subsidence and inundation were most common in brackish or salt marshes. The draining of wetlands for upland uses, such as rangeland, is another significant cause of wetland loss in Galveston Bay.

The loss of seagrasses has been even more significant than loss of wetlands. Seagrasses have decreased from approximately 2,500 acres in the 1950s to 700 acres in 1987, roughly a 70% loss of this habitat (GBNEP, 1994b). The reasons for the loss of seagrasses are not fully understood, but may be related to human activities, including land development, wastewater discharges, chemical spills, and dredging activities, a number of which can result in light attenuation and limit seagrass growth (Pulich and White, 1991). Another cause of the disappearance of seagrasses may be related to subsidence. The removal of natural berms resulting from subsidence may increase the wave energy impinging on seagrass beds and thus increase erosional forces (GBNEP, 1994b).

The loss of wetland and seagrass habitat could also be affecting both ecologically and economically important species; however, no studies have been able to document a causal relationship between species

abundance and habitat loss in Galveston Bay (GBNEP, 1994b). Although the loss of wetlands and seagrass habitat could affect the abundance of fish and shellfish that use these areas as a nursery, many of these species can survive and grow over open bay bottom (GBEP, 2002).

Galveston Bay is also home to a variety of birds, from colonial waterbirds to waterfowl and shorebirds. A recent study (McFarlane, 2001) investigated population trends in colonial waterbirds in Galveston Bay. Overall, the results were good: 10 species of birds had stable populations during the period 1973 to 1998, 8 species increased in population, and only 4 species—great blue heron, roseate spoonbill, least tern, and black skimmer—had decreasing populations. The reasons for the decrease in these four species are not clear. In the case of great blue herons and roseate spoonbill, a decrease in the quality or quantity of nesting and feeding habitat, such as wetlands, could be a factor (Walton and Green, 1993).

Status of Fisheries in Galveston Bay

Galveston Bay is an important source for both commercial and recreational species of fish and shellfish. Historically, the bay has been the leading producer of seafood in Texas and one of the leading producers in the Gulf of Mexico. In general, the fisheries appear to be meeting the needs of commercial and recreational fishers.

The status of fisheries in Galveston Bay was assessed primarily using commercial and recreational landings data provided by the TPWD. Seafood dealers provide information on commercial harvest of shrimp, oysters, crabs, and marine fish through a mandatory selfreporting system known as the Monthly Marine Products Report (Green et al., 1992). Where appropriate, fisheryindependent trawl and seine data, also collected by TPWD, were used to supplement landings data.

Public pressure led to a ban on the use of gill nets in all saltwater habitats in the late 1980s because valued non-target fish and mammals were being caught in the nets (Robinson, 2003). Twenty-year records of commercial landings of some commercial finfish species show overall decreases that are likely a result of that ban;

therefore, only data since 1990 have been used to examine a possible connection between landings and coastal condition.

Commercial Fisheries

The shrimp fishery is the largest commercial fishery in Galveston Bay, averaging approximately 7 million pounds, followed by the fisheries for oysters, blue crabs, and a variety of fish species (Table 9-3). Approximately 95% of the total annual commercial harvest in Galveston Bay is made up of shrimp, oysters, and blue crabs (GBNEP, 1994b).

Table 9-3. Average Harvest of Selected Commercial Species of Fish and Shellfish from Galveston Bay (GBEP, 2002)

	Weight (lbs)	Ex-vessel Value
Shrimp	6,948,629	\$9,969,989
Eastern oysters	3,919,514	\$8,412,810
Blue crab	1,992,007	\$1,240,167
Finfish	211,399	\$151,515

Values represent mean for years 1994-1998.

Shrimp

The commercial harvesting of shrimp in Galveston Bay rose to prominence in the 1920s. White and brown shrimp are the major species harvested in Galveston Bay, and pink shrimp are a minor component of the overall harvest and are usually counted as "browns." Slightly more white shrimp are caught in Galveston Bay than brown and pink shrimp (Green et al., 1992). Figure 9-4 shows the commercial harvest between 1990 and 2001 in Galveston Bay, during which time there was an overall increase. In terms of human use, this would appear to indicate the resource is meeting human use needs.

Eastern Oysters

Oysters are the second most important commercial species harvested in Galveston Bay. Most of the bay's large oysters reefs are located in mid-Galveston Bay (e.g., Redfish Reef and Redfish Bar) and also in East Bay (e.g., Hanna Reef), where fresh water from the tributaries mixes with saltwater from the Gulf of Mexico. Commercial landings of oysters increased

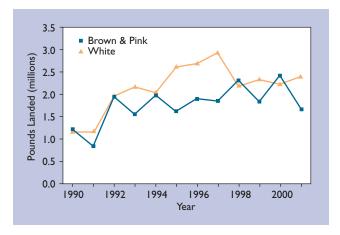


Figure 9-4. Commercial landings of shrimp in Galveston Bay, 1990–2001. Developed by NOAA for NCCR II. Data provided by Texas Parks and Wildlife Department (TPWD, 2003).

between 1990 and 2001 (Figure 9-5), and the fishery does not appear to have had an adverse impact on the size of existing oyster reefs (GBEP, 2004). Some of the most heavily fished reefs have not varied much in size since the 1850s, and there is even evidence of accretion on some reefs (GBNEP, 1994b). This resiliency of oysters is interesting not only because of the fishery pressure on the resource, but also because of other stressors, such as disease and predation. For example, the protozoan parasite known as "Dermo" (Perkinsus marinus) can cause annual mortalities in market oysters ranging from 10% to 50% (GBEP, 2002).

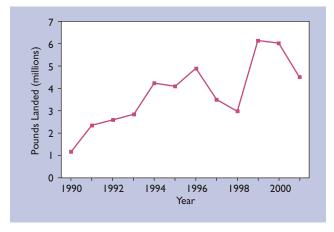


Figure 9-5. Commercial landings of oysters in Galveston Bay, 1990–2001. Developed by NOAA for NCCR II. Data provided by Texas Parks and Wildlife Department (TPWD, 2003).

Although the oyster population appears to be stable (even increasing in some areas), oyster harvesting is restricted in significant portions (43%) of Galveston Bay and is prohibited in small areas (1.5%) (GBEP, 2002). Growing water condition is determined based on observed concentrations of fecal coliform bacteria in the water. The presence of such bacteria is an indicator of the possible presence of pathogens from human or other mammalian fecal material entering the bay, usually from nonpoint terrestrial sources.

Oysters can be commercially harvested from restricted areas, but such harvesting is limited to those who hold privately leased, approved areas and can transport the oysters to these depurate areas prior to sale. The size of restricted areas decreased through the 1990s, opening more beds to all oystermen. This may account for part of the increase in landings over the same period. Another contributing factor is that the TPWD has limited the number of commercial licenses for shrimp and crabs since the mid-1990s, but not for oysters. Also, the recent low prices of shrimp have caused some fishers to target oysters rather than shrimp.

The presence of fecal coliform indicates that fecal waste has entered the estuary from human and other terrestrial sources. Fecal coliform can contaminate ovsters and cause disease in humans who consume them. A naturally occurring marine bacterium, Vibrio parahaemolyticus, can also be transmitted in raw oysters and cause very serious human disease and sometimes death. Periodic outbreaks of Vibrio parahaemolyticus require temporary total closures of oyster harvesting in the bay.

Blue Crabs

Blue crabs became an important fishery in Galveston Bay after 1960, partly because of the increasing commercial value of this species. Currently, more blue crabs are harvested out of Galveston Bay than out of any other Texas estuary (GBEP, 2002). The commercial harvest between 1990 and 2001 averaged 771 mt per year (Figure 9-6). An analysis of the landings data did not indicate any trends in landings data.

An analysis of fishery-independent blue crab trawl data (Figure 9-7) by TPWD, however, did reveal a negative trend in the number of adult crabs captured using a shrimp trawl between 1982 and 2000 (GBEP, 2002). Because the blue crab uses a variety of habitats

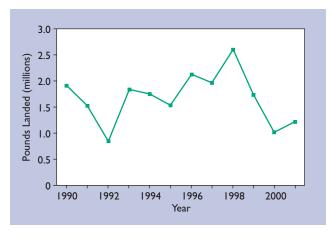


Figure 9-6. Commercial landings of blue crabs in Galveston Bay, 1990–2001. Developed by NOAA for NCCR II. Data provided by Texas Parks and Wildlife Department (TPWD, 2003).

in the bay during its fairly complex life cycle, a number of natural processes and human alterations could affect the population. Recruitment, however, does not appear to be a problem, because fishery-independent nearshore bag seine capture rates of juveniles appear fairly constant during the last 20 years. Although there is some evidence of contaminant stress in blue crabs inhabiting portions of the Houston Ship Channel (Engle and Thayer, 1998), fishing pressure may be a more likely explanation for the decline in the larger crabs sampled using the shrimp trawl. In 1997, to stem what appears to be overfishing, the TPWD imposed trap limits on the commercial crab industry, set size limits for blue crab males, prohibited the harvesting of egg-bearing females, and began a voluntary program to buy back licenses (Robinson, 2003).

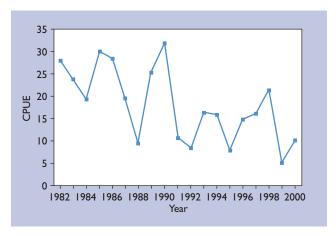


Figure 9-7. Blue crab trawl data, 1982–2000 (GBEP, 2002).

Finfish Landings

In the late nineteenth century, the commercial harvest of seafood from Galveston Bay was evenly divided between finfish and oysters (GBNEP, 1994b). Currently, the finfish commercial harvest accounts for less than 5% of the total commercial seafood harvest from Galveston Bay. The average annual commercial harvest of finfish between 1990 and 2001 was 87 mt. The ex-vessel value of finfish in Galveston Bay averaged approximately \$150,000 annually (GBEP, 2002).

A variety of finfish are harvested commercially in Galveston Bay, including black drum, southern flounder, sheepshead, and mullet (Figure 9-8). These four species make up more than 60% of the commercial finfish harvest. Some of these same species are also caught by recreational fishers. Although there is variability in the harvest from year to year, there was no decline in any of the species harvested between 1990 and 2001. There are decreases, however, when data are viewed for the longer period of 1980 to 2001, but these decreases are largely the result of high harvests made in the early 1980s before gill netting was banned.

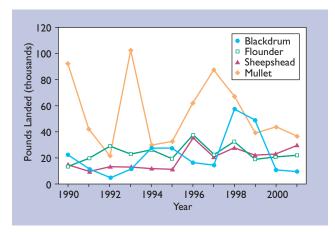


Figure 9-8. Commercial landings of selected fish species in Galveston Bay, 1990–2001. Developed by NOAA for NCCR II. Data provided by Texas Parks and Wildlife Department (TPWD, 2003).

Recreational Fisheries

The recreational harvest of fish is an important part of the economy in Galveston Bay. Approximately 50% of all recreational fishing expenditures in Texas occur in Galveston Bay (GBEP, 2002). In the five counties that surround the bay, more than 260,000 recreational fishing licenses were sold in 1998 and 1999 (GBEP, 2002). In addition to compiling information on the commercial fisheries, the TPWD also collects data on the recreational harvest of finfish. The top five recreational species in terms of the number of fish caught is provided in Figure 9-9. Between 1990 and 2001, sand seatrout, spotted seatrout, and Atlantic croaker had the highest landings, based on the TPWD survey. Of the five species shown in Figure 9-9, only one—the southern flounder—had a negative trend in recreational landings. It is not clear why this occurred. Fisheryindependent bag seines of southern flounder by TPWD have shown a nearly stable, slightly increasing trend in CPUE. Overall, the recreational harvest of these species seems to be meeting the needs of recreational fishers in Galveston Bay.

In summary, both the commercial and recreational fisheries in Galveston Bay appear to be meeting human use needs. In the fishery-independent data, there is some evidence of a decreasing blue crab population, but the decrease may be related more to overfishing than to environmental quality.

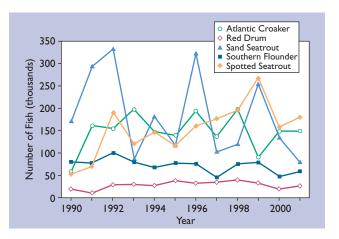


Figure 9-9. Recreational (private boat) landings of selected fish species in Galveston Bay, 1990-2001. Developed by NOAA for NCCR II. Data provided by Texas Parks and Wildlife Department (TPWD, 2003).

Can the Fish Be Eaten?

There would be little point to commercial fishing if the product could not be safely consumed. Recreational fishing, however, has all sorts of benefits in addition to eating the catch. Nonetheless, it is important to determine whether the fish can be eaten safely. The Texas Department of Health (TDH) has declared that "all species of fish and crabs from areas of Galveston Bay south of a line from Red Bluff Point to Five Mile Cut Marker to Houston Point can be eaten without restrictions" (TDH, 2001). However, the TDH declared an advisory area for 50 square miles north of this line (at the point where the channel opens to the wide portion of the bay and back toward the city of Houston), for parts of Buffalo Bayou, for the Houston Ship Channel, and for the lower San Jacinto River. These areas represent about 8% of Galveston Bay.

Since 1990, the TDH has advised that crabs and catfish taken within this advisory area not be eaten by children, women who are pregnant, nursing mothers, or women who may become pregnant, and only be eaten in one 8-ounce portion per month by all others, because of elevated levels of dioxin. Elevated levels of chlorinated pesticides, PCBs, and dioxins caused the TDH to recommend the same consumptive restrictions for all fish species, in addition to crabs and catfish, taken in a small subsection of this area in 2001. The area included the 15 square miles within the upper Houston Ship Channel that extend from the San Jacinto River to Houston.

Human Uses and National Coastal Condition Report Environmental Indicators

With the exception of fish contamination in a small area, reduced benthic conditions at 8 of 10 NCA locations, and restrictions on oyster harvesting over wider areas, Galveston Bay is meeting the demands imposed on it by human uses. Moreover, in terms of the coastal condition indicators used in this report, it is meeting human use needs and maintaining a fair ecological condition. The chlorophyll a and total nitrogen indices at the 10 NCA sites were all rated as good or fair. Dissolved oxygen in bottom water is good at eight sites and fair in the other two sites. Phosphorus concentrations, however, were poor at seven sites and only fair at three. None of the sediment samples at any site, except the Houston Ship Channel site, showed sufficient chemical contamination to classify sediment as anything other than good. The NOAA Bioeffect Surveys (summarized in Chapter 2, National Coastal Condition) showed the same results at its 75 sites. There was no toxicity, as measured by 10-day amphipod survival (although 80% of the sites are listed as missing sediment toxicity data), and no cases where sediment guidelines were exceeded, except one site in the Houston Ship Channel. Benthic community conditions, however, were poor at two sites and fair at six sites.

The Galveston Bay estuary system is maintaining a fair ecological condition, despite the many demands from human uses. However, continued surveillance to detect any early warning signs of ecological degradation from the current conditions would be prudent.